



**American Water Works
Association**

The Authoritative Resource on Safe Water®

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AWWA Standard

Polyacrylamide



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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

SEC.	PAGE	SEC.	PAGE
Foreword			
I	Introduction..... vii	4.3	Qualifications..... 3
I.A	Background..... vii	4.4	Physical Requirements 4
I.B	History..... viii	4.5	Chemical Requirements 4
I.C	Acceptance ix	4.6	Impurities 5
II	Special Issues..... x	4.7	Inert Substances 6
II.A	Safety x	5	Verification
II.B	Spill Control..... x	5.1	General 6
III	Use of This Standard xi	5.2	Sampling..... 7
III.A	Purchaser Options and Alternatives xi	5.3	Visual Inspection 7
III.B	Modification to Standard..... xv	5.4	Test Procedures..... 8
IV	Major Revisions xv	5.5	Solution Preparation 15
V	Comments xv	5.6	Product Performance 18
		5.7	Residual Acrylamide Monomer..... 20
		5.8	Notice of Nonconformance 21
		5.9	Manufacturing Location Contact for Quality Control Inquiries..... 21
Standard			
1	General	6	Delivery
1.1	Scope 1	6.1	Markings..... 22
1.2	Purpose 1	6.2	Packaging and Shipping..... 22
1.3	Application 1	6.3	Affidavit of Compliance..... 23
2	References 2	Table	
3	Definitions 2	1	Typical Concentrations and Ranges for Determining Brookfield Viscosity 5
4	Requirements		
4.1	Materials 3		
4.2	Description 3		

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA B453.

I. Introduction.

I.A. *Background.* Chemical clarification methods have been used to improve the quality of drinking water supplies since the late 1880s. In 1967, the first completely synthetic organic polyelectrolyte was accepted by the US Public Health Service for use in treatment of potable water. The responsibility for accepting additives for drinking water treatment was subsequently assumed by the US Environmental Protection Agency (USEPA) and administered by their Office of Drinking Water as an advisory program. USEPA's acceptance was by the specific name of the suppliers' product and not by generic type. Polyacrylamide (CAS* No. 9003-05-8) is one of several types of synthetic organic polyelectrolytes that were accepted for use in potable water treatment under this program, which was discontinued in 1990.

Polyacrylamides (PAMs) belong to a family of synthetic organic polyelectrolytes (also called polymers or flocculants) used in water treatment to improve the performance of some unit operations in the treatment process, most often by increasing the extent or rate of liquid–solids separation. PAMs may have an anionic, nonionic, or cationic charge and will always have a high relative molecular weight. Because of this high molecular weight, they are manufactured for the potable water supply service in three distinctly different product forms: powders, emulsions, and solutions. The solution form is the least frequently used because of its high viscosity and lower polymer content. An aqueous dispersion form may be available in the future.

The important concepts to remember regarding PAMs include the following:

1. PAMs differ from polyDADMAC polymers (ANSI/AWWA Standard B451, Poly [Diallyldimethylammonium Chloride]) and epichlorohydrin-DMA polymers (ANSI/AWWA Standard B452, EPI-DMA Polyamines) in their use, handling, storage, and solution preparation.
2. PAMs are not one polymer, but a family of polymers that differ in product form, charge type, charge density, molecular weight, and other properties.

*Chemical Abstracts Service, 2540 Olentangy River Road, P.O. Box 3012, Columbus, OH 43210.

3. The nomenclature used to describe the four forms in which PAMs are supplied is

- a. Powders (also called flake, dry, granular, or bead).
- b. Emulsions (also called liquids, dispersions, or inverse emulsions).
- c. Solutions (also called liquids, aqueous solutions, or viscous solutions).
- d. Aqueous dispersions (also called oil-free emulsion, water dispersion, brine dispersion).

4. The physical properties of a PAM cannot usually be used to judge product performance. Only through laboratory testing, pilot-plant studies, or full-plant trials can product efficacy be discerned.

5. PAMs may or may not contain inactive ingredients, such as hydrocarbon solvents, surfactants, and salts, depending on the product form, manufacturing method, and formulation. The typical primary components of each form can be described generically as follows:

- a. Powders (PAM, moisture [water]; may contain inert inorganic salts or inert organic compounds).
- b. Emulsions (PAM, hydrocarbon oil, water, surfactants). The amount of hydrocarbon oil is typically, but not limited to, 20 percent to 50 percent by weight of the emulsion.
- c. Solution (usually a dilute, viscous, aqueous solution of powder or emulsion form PAM. Refer to the aforementioned primary components).
- d. Aqueous dispersions (PAM, water, salts) in which the PAM is suspended in aqueous solution of inorganic salts. Aqueous dispersion PAMs are currently used for wastewater treatment and may be introduced in the future for potable water supply treatment subject to appropriate approvals. These products contain no hydrocarbon oil or surfactants.

The user should consult the material safety data sheet (MSDS) for product composition information regarding any specific PAM product.

6. The storage, dissolution, and feeding of PAMs may require specific procedures, considerations, and equipment that are unique for each product form (powders, emulsions, and solutions).

I.B. History. Authorization for development of this standard was given by the AWWA Standards Council. The standard was developed by the AWWA Standards Committee on Polyelectrolytes and the first edition was approved by the AWWA Board of Directors on Feb. 4, 1996. Subsequent action was approved by the Board of

Directors on June 17, 2001. This third edition was approved by the AWWA Board of Directors on Feb. 12, 2006.

I.C. *Acceptance.*^{*} In May 1985, USEPA entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.[†] Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including two standards developed under the direction of NSF, NSF[‡]/ANSI[§] 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 60. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, “Toxicology Review and Evaluation Procedures,” to NSF/ANSI 60 does not stipulate a Single Product Allowable Concentration (SPAC) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The SPACs of an unspecified list of “unregulated contaminants” are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

^{*}See Sec. 4.6.2, which gives the USEPA Treatment Technique requirements for residual acrylamide monomer in polyacrylamide polymers.

[†]Persons outside the United States should contact the appropriate authority having jurisdiction.

[‡]NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48113.

[§]American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

ANSI/AWWA B453 addresses additives requirements in Sec. 4.6 of the standard. The transfer of contaminants from chemicals to processed water or the residual solids is becoming a problem of greater concern. The language in Sec. 4.6.4 is a recommendation only for direct additives used in the treatment of potable water to be certified by an accredited certification organization in accordance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects. However, users of the standard may opt to make this certification a requirement for the product. Users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements including applicable standards.
2. Determine the status of certifications by all parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

II. Special Issues.

II.A. *Safety.* PAMs are not considered to be as toxic as some household products nor are they considered to be primary skin or eye irritants as defined by the Consumer Product Safety Commission (US Federal Hazardous Substances Act). Good housekeeping procedures and personal cleanliness are recommended when handling polyacrylamides. The products may contain trace amounts of acrylamide monomer, which has been shown to be toxic. The MCL of 0.05 percent is lower than that which would require labeling under the Occupational Safety & Health Administration (OSHA) Hazard Communication Standard.

Safety glasses should be worn when handling emulsion or solution forms of PAM and, although not required, when handling the powder form. Appropriate first-aid practices should be followed in all cases of exposure. In case of eye contact, flush with plenty of water for at least 15 min and call a physician. Emulsion-form PAMs contain hydrocarbon solvents whose vapors can cause nausea, headaches, and other symptoms. Consult the MSDS for the specific product for safety procedures before handling any PAM product.

II.B. *Spill Control.* Dispose of PAMs according to federal, state, local, and provincial regulations. Solutions of PAMs make floors and other surfaces extremely slippery. A dike should be formed around the spill area to contain as much spilled material as possible and the contained material should be shoveled, scooped, or pumped, as appropriate, into suitable disposal containers. Any remaining material should be adsorbed on vermiculite or other suitable adsorbing material and placed in

a sealed metal container for disposal. The spill area should be thoroughly washed with water only after all possible polymer has been scooped up, absorbed, or wiped up. Use of warm water is beneficial.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

This AWWA standard can be used to prepare a purchase specification but is not itself a specification because it cannot address requirements unique to the purchaser's specific situation, nor does it establish business relationships or set additive requirements (MCL or maximum-use dosage). In addition, this PAM standard does not establish physical and chemical property specifications for any one PAM product for two reasons: (1) PAMs are a broad family of products differing widely in properties and product form, and (2) physical and chemical properties of PAMs do not always relate to their performance as a flocculant in specific applications.

III.A. Purchaser Options and Alternatives. The following items should be provided by the purchaser.

Sec. III.A.1 through Sec. III.A.6 detail requirements that the user may consider when developing a PAM product purchase specification.

III.A.1. General Product Requirements.

III.A.1.1. Additive requirements (Sec. I.C). The following requirements should be met for additives:

1. Certification under the earlier USEPA advisory program or the current NSF/ANSI 60.
2. Compliance with USEPA Phase II Rule National Primary Drinking Water Regulations acrylamide monomer treatment technique requirements (40 CFR 141.111).
3. Approval by or certification that meets any applicable state or local requirements.
4. Whether the recommended compliance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, is to be required. If this certification is to be required, the purchaser's specifications shall read, "This material shall be certified as suitable for contact with or treatment of drinking water by an accredited certification organization in accordance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects."

III.A.1.2. Residual acrylamide monomer (Sec. I.C of the foreword, and Sec. 4.6.2, Sec. 5.7). The acrylamide monomer content of each shipment and lot of PAM shall be no greater than 0.05 percent by weight of the active polymer content based on a dose level of 1 mg/L active PAM polymer (or equivalent). Upon request, the supplier shall provide an estimate of the residual acrylamide monomer content. This estimate shall be based on the maximum concentration of residual acrylamide monomer and shall be reported as less than or equal to that concentration.

NOTE: It may not be possible for the supplier to routinely provide the precise value of the residual acrylamide monomer of each PAM shipment. Such measurements are conducted on each manufactured batch, which may be continuously added to bulk storage tanks from which shipments are continuously extracted.

III.A.1.3. Impurities (Sec. 4.6).

III.A.2. User Specific Requirements.

1. Description of application.
2. Estimated annual purchase requirements (lb [kg]).
3. Typical order size (number of containers and (lb [kg])).
4. Packaging (superbag, bag, fiber drum, pails, drum and drum size, returnable semibulk containers, nonreturnable semibulk containers, bulk by truck, bulk by rail) (Sec. 6.2).
5. Marking (Sec. 6.1).
6. Shipping (Sec. 6.2).
7. Delivery requirements (truck with a lift gate; length and coupling size of hoses needed for bulk delivery; transfer pump; allowed times of delivery; limitations on truck size or weight; sampling protocol; other).
8. Order lead time (number of days between order placement and delivery necessary if typical lead times are insufficient).
9. Affidavit of compliance (Sec. 6.3).
10. Origin of material (Sec. 5.9).
11. Shipping and billing addresses.
12. Financial terms.
13. Insurance/performance bond requirements.
14. Other user-specific requirements.

III.A.3. Product Form Requirements (Sec. I.A, Sec. 4.2, Sec. 4.3). Restricting purchase specifications to a single PAM product form (powder, emulsion, or solution) may be dictated by the capabilities of the available feeding and storage